Dec. 15, 1942. R. B. PRICE ET AL 2,305,388

RODLESS BOTTOM HOLE PUMP

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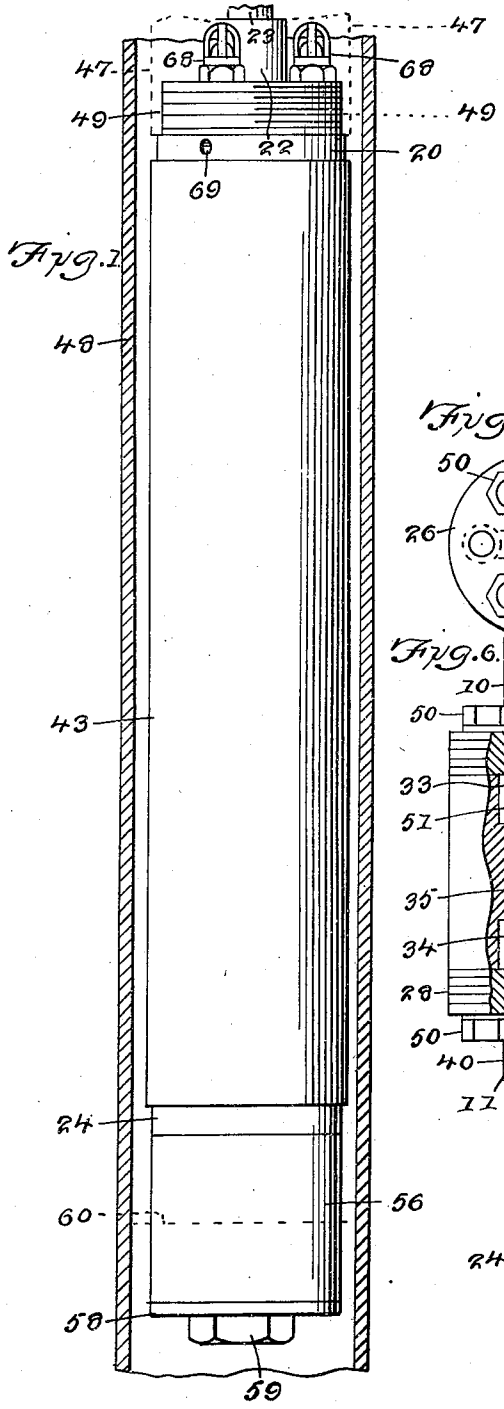


Fig. 1.

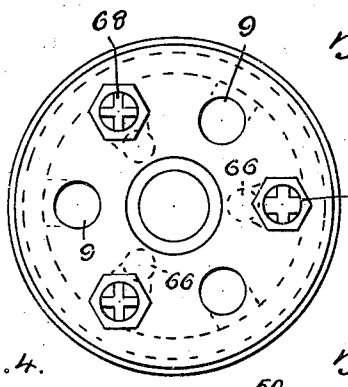


Fig. 3.

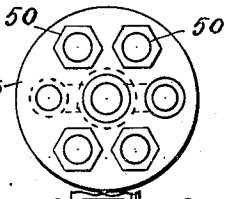


Fig. 4.

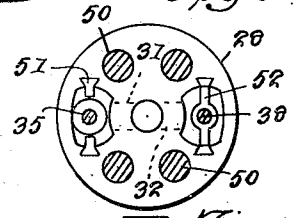


Fig. 5.

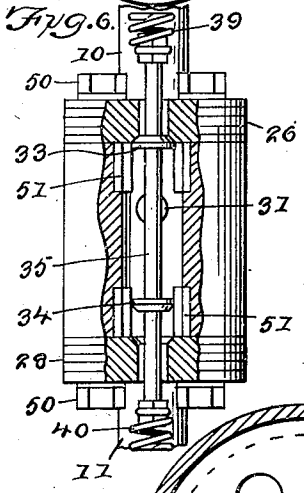


Fig. 6.

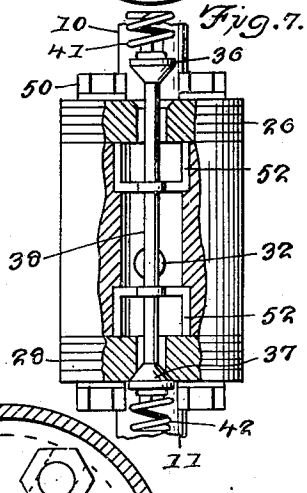


Fig. 7.

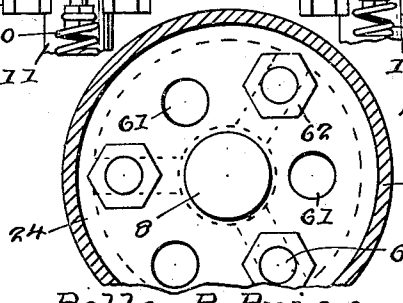


Fig. 8.

Rollo B. Price
Oscar K. Hobbs INVENTOR
BY Victor J. Evans & Co.
ATTORNEYS

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Fig. 2.

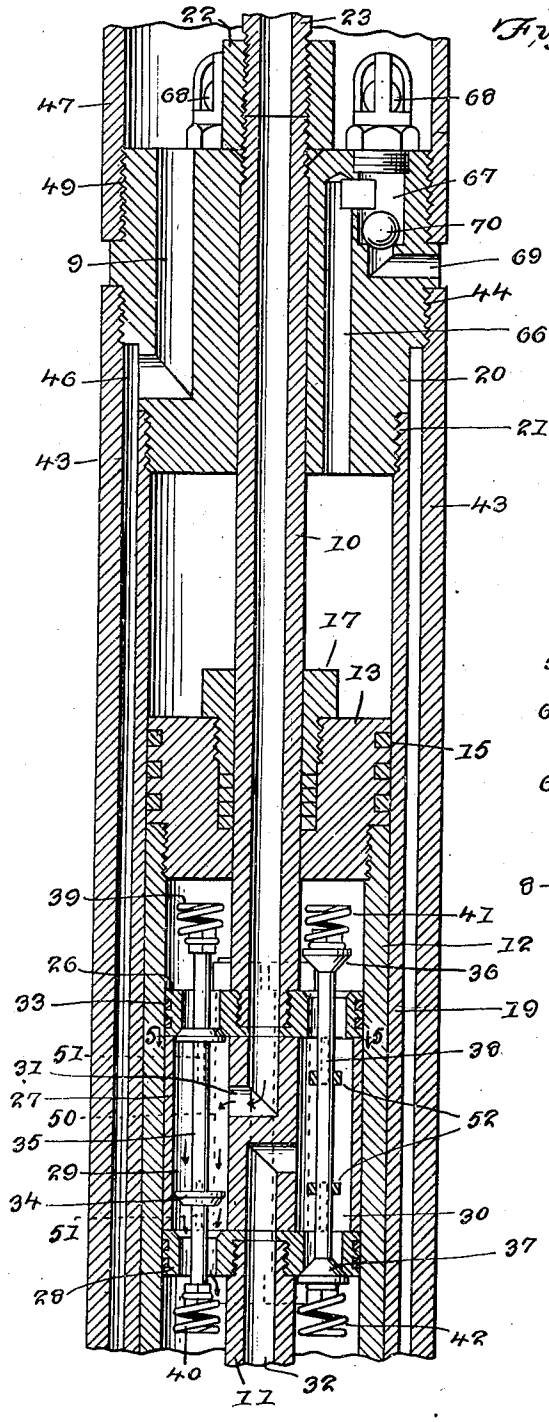
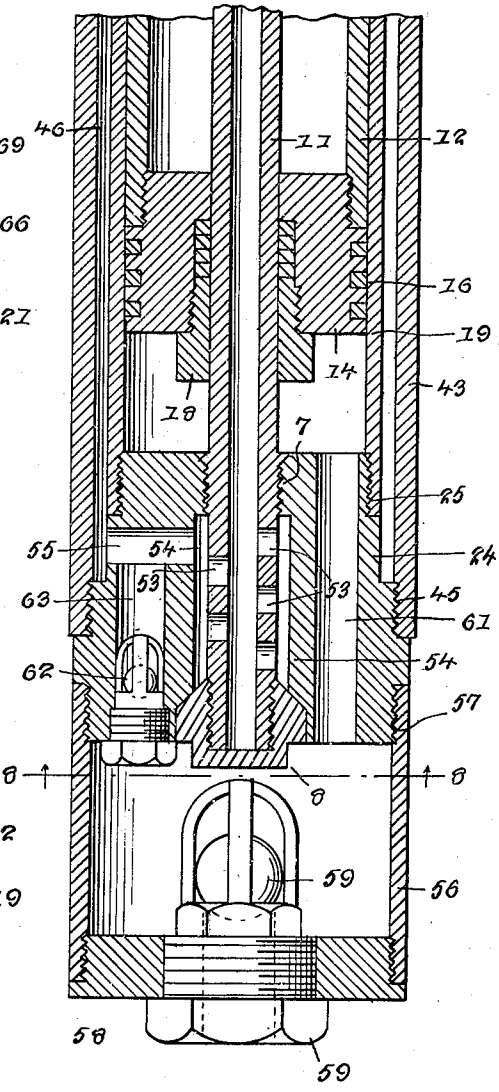


Fig. 2a.



Rollo B. Price
Oscar K. Hobbs
INVENTOR

BY Victor J. Evans & Co.
ATTORNEYS

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RODLESS BOTTOM HOLE PUMP

Rollo B. Price, Sweeny, and Oscar K. Hobbs, Abilene, Tex.

Application May 9, 1941, Serial No. 392,772

2 Claims. (Cl. 103—46)

This invention relates to a rodless bottom hole pump and has for an object to provide a pump of this kind having a reciprocating cylinder and a stationary piston, the reciprocating cylinder eliminating the necessity of two separate units, a power unit and a pump unit, the reciprocating cylinder promoting the construction of a double action pump in a unit, thereby enabling it to be lowered in crooked wells, and also permitting of the maximum amount of the enclosed space of the unit being utilized for pumping the well fluid.

A further object is to provide a device of this character having a stationary piston which contains mechanically operated intake and exhaust valves thereby eliminating the use of valve length rods, levers or rocker arms.

A further object is to provide a stationary piston having valves, poppet in this case, provided with controlling springs adapted to be struck by the upper and lower heads of the reciprocating cylinder to give the valves fast motion, once the valve has been opened, the springs also carrying valves to new position after the reciprocating cylinder has lost its motion.

A further object is to provide a device of this character having a hollow stationary piston rod for supplying fluid pressure medium to the stationary piston for controlling the valves of the piston.

A further object is to provide a device of this character which will be formed of a few strong, simple and durable parts, which will be inexpensive to manufacture, and which will not easily get out of order.

With the above and other objects in view, the invention consists of certain novel details of construction and combinations of parts hereinafter fully described and claimed, it being understood that various modifications may be resorted to within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings forming a part of this specification:

Figure 1 is a side elevation of the pump with the well casing shown in longitudinal section.

Figure 2 is a longitudinal sectional view of the upper portion of the pump drawn to large scale.

Figure 2a is a longitudinal sectional view of the lower portion of the pump drawn to large scale.

Figure 3 is a top plan view of the pump.

Figure 4 is a top plan view of the stationary piston with the valves removed.

Figure 5 is a cross sectional view of the piston taken on the line 5—5 of Figure 2 looking in the direction of the arrows.

Figure 6 is a side elevation, with a portion broken away, of the piston showing the valves on one side thereof.

Figure 7 is a side elevation, with a portion broken away, of the piston showing valves on the other side thereof.

Figure 8 is a cross sectional view taken on the line 8—8 of Figure 2, showing the bottom head of the stationary cylinder.

Referring now to the drawings in which like characters of reference designate similar parts in the various views, 10 and 11 designate two aligned hollow stationary piston rods. A reciprocating cylinder 12 is arranged concentric with the piston rods. The reciprocating cylinder is closed at the ends by upper and lower heads 13 and 14 which have respective packing rings 15 and 16. The upper stationary piston rod 10 is engaged through the upper head 13, and a gland nut 17 provides a pressure tight connection between the piston rod and the head. The lower stationary piston rod 10 passes through the lower head 14, and a gland nut 18 provides a pressure tight connection between the piston rod and the head.

The reciprocating cylinder 12 is movable vertically endwise in an outer stationary cylinder 19. The outer stationary cylinder is closed at the upper end by a head 20, which has a screw thread connection 21 with the stationary cylinder wall. The upper stationary piston rod 10 passes upwardly through the head and is fixed to the head by a nut 22 which also connects the piston rod to a pressure pipe 23 which extends upwardly to the top of the oil or other well and is connected to a suitable source of fluid pressure medium at the top of the well. The outer stationary cylinder 19 is closed at the lower end by a head 24 which has a screw thread connection 25 with the stationary cylinder wall and the lower stationary piston rod 11 is fixed to the head by a nut 8 and screw thread connection 7, see Figure 2a.

The lower end of the upper stationary piston rod is screw threadedly connected to the upper head 26 of a piston 27 which is stationary in the reciprocating cylinder 12. The upper end of the lower stationary piston rod 11 is screw threadedly engaged with the lower head 28 of the piston. Thus, it will be seen that the hollow stationary piston rods are fixed at their adjacent ends to the stationary piston, while at their remote ends the stationary piston rods are fixed to the heads of the outer stationary cylinder.

The stationary piston 27 is provided with a longitudinal intake chamber 29 and a longitudinal exhaust chamber 30, shown in Figure 2. The intake chamber communicates with the upper stationary piston rod 10 through a passage 31. The exhaust chamber communicates with the lower stationary piston rod 11 through a passage 32. Two valves 33 and 34 are mounted on a common stem 35 in the intake chamber. Two valves 36 and 37 are mounted on a common stem 38 in the exhaust chamber. The stem 35 extends above and below the piston and is equipped at its ends with respective helical springs 39 and 40. The stem 38 extends above and below the piston and is equipped at its ends with helical springs 41 and 42. The function of the helical springs is to contact with the heads of the reciprocating cylinder during movement of the cylinder to mechanically operate the valves without the use of rods, levers or rocker arms.

The arrangement of the valves in the intake chamber is such that when the upper valve 33 is closed, the lower valve 34 is open and vice versa. Likewise the arrangement of the valves in the exhaust chamber are such that when the upper valve 36 is open the lower valve 37 is closed. In practice the upper valve of the intake chamber is closed when the upper valve in the exhaust chamber is open and the lower valve in the intake chamber is open when the lower valve in the exhaust chamber is closed.

A pump housing 43 has a screw thread connection 44 with the upper head 20 of the outer stationary cylinder 19 and has a screw thread connection 45 with the lower head 24 of the outer stationary cylinder. A space 46 exists between the outer stationary cylinder 19 and the pump housing 43. From this space the well liquid that enters the lower half of the unit by the ball 59 is forced up to the top of the well through ports 9 in the upper head 20 of the outer stationary cylinder 19 and a pipe 47, which is disposed within the well casing 48 and which has a screw thread connection 49 with the upper head of the outer stationary cylinder.

As best shown in Figure 4, the heads 26 and 28 of the stationary piston 27 are assembled with the piston by four bolts 50. The heads of the piston are formed with seats for the valves so that removal of the bolts permits disassembly of the piston and valves for inspection and repairs. It will be noted by referring to Figure 6 that the valves 33 and 34 of the intake chamber are comparatively small and are disposed within the piston and are guided by suitable guides 51 disposed within the chamber. On the other hand the valves 36 and 37 of the exhaust chamber, as best shown in Figure 7, are comparatively large and are disposed exteriorly of the piston. Suitable guides 52 disposed in the exhaust chamber engage the stem of the valves to direct movement of the valves.

The piston, valves, and reciprocating cylinder coact with each other as follows: As shown in Figure 2, the reciprocating cylinder 19 is nearing the bottom of its down stroke and fluid pressure medium is entering the intake chamber 29 through the upper hollow piston 10 to hold the upper valve 33 closed while escaping through the open lower valve 34 into the space between the lower head of the piston and the lower head 14 of the reciprocating cylinder to force the cylinder downward. At the bottom of stroke, the upper head 13 of the reciprocating cylinder strikes the helical springs 39 of the valves and reverses the position of the valves. Fluid pressure medium will now flow through the upper stationary piston rod 10 into the intake chamber and hold the lower valve 34 closed, while escaping through the upper open valve 33 into the space between the top of the piston and the upper head 13 of the reciprocating cylinder to force the cylinder upward. Thus, the reciprocating cylinder is actuated without the use of a sucker rod and its necessary weight, to pump liquid from the well.

Again referring to Figure 2, it will be seen that when the reciprocating cylinder is moving on its down stroke, the lower valve 37 of the exhaust chamber is closed and the upper valve 36 is open to permit fluid pressure medium between the piston and the upper head 13 of the cylinder to escape through the open valve 36, exhaust chamber 30, passage 32 through the lower stationary piston rod 11, see Figure 2a, and through ports 53, chamber 54, and passage 55 in the lower head 24 of the stationary outer cylinder, into the liquid space 46. Thus, the cylinder may move down freely under impulse of the fluid pressure against its lower head 14. When the upper head 13 of the reciprocating cylinder strikes the springs 39 and 41, the position of the valves is reversed from that shown in Figure 2. Thus, the upper valve 36 of the exhaust chamber is in closed position and the lower valve open so that fluid pressure medium between the lower head of the reciprocating cylinder and the bottom of the piston may escape into the exhaust chamber 30, passage 32, lower stationary piston 11, ports 53, chamber 54 and passage 55 into the space 46. Thus, the cylinder may move up freely under impulse of the fluid pressure against its upper head.

A pump housing extension 56 is screw threadedly engaged, as shown at 57, with the lower head 24 of the stationary cylinder and is closed at the bottom by a plug 58 which carries a conventional upwardly opening ball valve 59. The entire unit is submerged several feet below fluid level. During upstroke of the reciprocating cylinder, liquid will be sucked from the well through the open valve 59 and through a passage 61 in the lower head 24 of the stationary cylinder into the space between the lower head 14 of the reciprocating cylinder and the lower head 24 of the stationary cylinder. During down stroke of the reciprocating cylinder, the entrapped liquid will be forced back through the passage 61, into the housing extension 56, closing the valve 59, and escaping from the extension through an upwardly opening conventional ball valve 62, which controls a passage 63 formed in the lower head 24 of the stationary cylinder, which passage communicates with the passage 55 leading into the liquid space 46. Simultaneously well fluid is being drawn into the upper stationary cylinder through the passage 69.

The upper head 20 of the stationary cylinder is provided with a passage 66 which opens through the bottom of the head and opens into a passage 67, which opens at the upper end through the top of the head and is controlled by an upwardly opening ball valve 68. The lower end of the passage 67 communicates with a laterally extending passage 69 which is controlled by a downwardly seating ball valve 70. During upstroke of the reciprocating cylinder, fluid entrapped between the upper head 13 of the cylinder and the upper head 20 of the stationary cylinder will be discharged through the passage 66, passage 67 and open ball valve 68 into the body of liquid in the well pipe 47. During down

stroke of the reciprocating cylinder, fluid in the well casing 48 will be drawn through the passage 69, past the open ball valve 70 and through the passage 66 into the space between the upper head 20 of the outer stationary cylinder and the upper head 13 of the reciprocating cylinder.

Preferably, as shown in Figure 3, there are three ports 9 in the upper head 20 of the stationary cylinder. Preferably, there are three passages 66, valve controlled as above described. As shown in Figure 8, preferably there are three passages 61 formed in the lower head 24 of the stationary cylinder, and preferably there are three passages 63 controlled by respective upwardly opening ball valves 62.

Since the operation of the parts has been described as the description of the parts progressed, it is thought the invention will be fully understood without further explanation.

What is claimed is:

1. In a well pump, a stationary cylinder, a reciprocating cylinder in the stationary cylinder for pumping well liquid into and out of both the lower end of the stationary cylinder and the upper end of the stationary cylinder, valve controlled passages for discharging liquid from both the lower end of the stationary cylinder and the upper end of the stationary cylinder, a stationary hollow piston in the reciprocating cylinder, heads bolted to the piston formed with valve seats, upper and lower hollow stationary piston rods fixed at their remote ends to the heads of the stationary cylinder and fixed at their adjacent ends to the heads of the piston, intake and exhaust valve chambers in the piston communicating respectively with the upper and the lower piston rods, a pair of valves on a single stem for each chamber, said valves seating on said valve seats, removal of the bolts of the heads permitting removal of the valves for inspection and repairs, each stem projecting above and below the piston, one of the valves of each pair being open when the other is closed, helical springs on the ends of each stem for contact with the heads of the reciprocating cylinder for actuating the valves, means connecting the upper piston rod to a source of fluid pressure medium, and means venting the lower piston rod to the exterior of the stationary cylinder, the valves of the inlet chamber supplying fluid pressure medium from the upper piston rod against the heads of the reciprocating cylinder alternately to reciprocate the cylinder, the valves of the exhaust chamber venting fluid pressure medium from against the heads of the reciprocating cylinder alternately into the lower piston rod.

2. In a well pump, a pump housing, a stationary cylinder in the housing, a cylinder mounted for reciprocation within the stationary cylinder adapted to pump well liquid from the lower end of the stationary cylinder into the pump housing, a stationary hollow piston disposed within the reciprocating cylinder, heads bolted to the piston formed with valve seats, two hollow stationary piston rods for conducting fluid pressure medium to and from the piston fixed at their remote ends to the heads of the stationary cylinder and fixed at their adjacent ends to the heads of the stationary piston, liquid tight connections between the reciprocating cylinder and the piston rods, liquid tight connections between the heads of the reciprocating cylinder and the stationary cylinder, an intake and an exhaust chamber for fluid pressure medium in the stationary piston, the intake chamber communicating with the upper piston rod and the exhaust chamber communicating with the lower piston rod, two valves for each chamber fixed on a single stem which extends above and below the stationary piston, said valves seating on said valve seats, removal of the bolts of the heads permitting removal of the valves for inspection and repairs, helical springs on the ends of the stems for contact by the heads of the reciprocating cylinder to actuate the valves, one of the intake and one of the exhaust valves being seated while the other is unseated to simultaneously admit fluid pressure medium to one end of the reciprocating cylinder and release fluid pressure medium from the other end of said cylinder for reciprocating the cylinder, and means in the heads of the stationary cylinder controlling flow of well liquid through the pump housing.

ROLLO B. PRICE.
OSCAR K. HOBBS.